Five Operational Lessons from the Battle for Mosul

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Members of the Iraqi Federal Police carry suicide belts of the type that were used by Islamic State militants 9 July 2017 in the Old City of Mosul, Iraq. (Photo by Alaa Al-Marjani, Reuters)

Future large-scale combat operations in urban areas will be similar to the operation to liberate Mosul from the Islamic State. Four key aspects of the battle foreshadow the most likely future of urban warfare for the U.S. Army: *corps-sized formations* conducting *multi-domain operations* as a *coalition force* in *dense urban environments* (DUEs).[1]

Five Key Observations Regarding Urban Warfare in Mosul

In conjunction with the four key aspects noted above, analysis of the battle for Mosul further reveals five observations that should guide the operational approach to the next urban fight: (1) it is impossible to isolate a modern city, (2) difficulty increases with depth and duration, (3) attackers lose the initiative once they enter the city, (4) dense urban terrain enhances sustainment, and (5) operational reach is proportional to population support.

The Battle for Mosul was the first large-scale combat operation (LSCO) with U.S. participation since the 2003 invasion of Iraq.[2] The coalition's objective was to recapture the city from the Islamic State (IS) as part of a joint, interagency, intergovernmental, and multinational (JIIM) campaign to restore Iraqi sovereignty, degrade IS military capability, and ultimately defeat IS as a proto-state.[3] Although IS was not a U.S.-peer competitor, it ingeniously exploited Mosul to contest coalition capabilities in multiple domains.[4] For astute observers, the battle for Mosul portends future urban combat operations against peer-adversaries: a corps-level multinational coalition conducting large-scale multi-domain operations in contested DUEs.[5]

Large-Scale Combat Operations in Dense Urban Environments

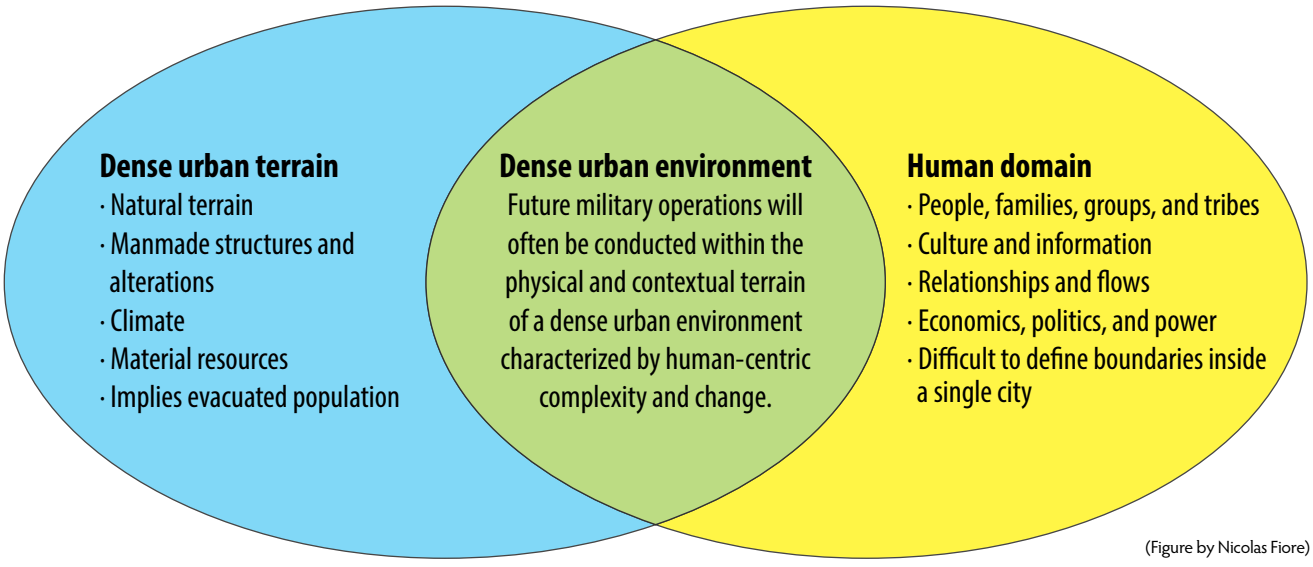
The U.S. Army updated Field Manual (FM) 3-0, *Operations*, in 2017 to provide a doctrinal foundation for LSCO against a modern peer adversary.[6] In *Operations*, the Army envisions a continuum of shaping, combat, and consolidation activities occurring simultaneously across an area of operations. Departing from the brigade-centric operations of the past decade, the Army will require division and corps headquarters to conduct more tactical action in close combat operations.[7] Although U.S. soldiers did not conduct close combat in Mosul, the U.S. Army did participate in LSCO by supporting the continuum of activities described in FM 3-0 for a coalition corps of more than one hundred thousand soldiers.[8] Echelons above brigade synchronizing large-scale operations in contested DUEs will become a hallmark of future operations—even irregular campaigns such as stability and counterinsurgency operations. Figure 1 (on page 59) depicts how dense urban terrain and the characteristics of its associated population come together to form DUEs.

Urban terrain is both universal and unique in warfare. Historically, societies, cities, and warfare evolved together.[9] The means of warfare are typically drawn from urban areas, and campaigns usually focus on urban objectives as the adversary's traditional seat of power and authority. Coupling global urbanization with historical realities, U.S. doctrine envisions military operations in cities as an "inevitable norm."[10]

Every type of terrain has its favorable and unfavorable characteristics, but a city is the only severely restricted terrain with the population and infrastructure to both sustain and shield a large army.[11] Current doctrine focuses on population centers greater than one hundred thousand inhabitants because they are typically more dense and complex than villages or towns.[12] Joint Publication (JP) 3-06, *Urban Operations*, characterizes urban environments using an *urban triad* of three parts: the terrain, the population, and the supporting infrastructure.[13] Large cities are unique because they contain all three components of the urban triad in sufficient concentration to require one or more divisions to control. A town may have thousands of people and hundreds of concrete structures packed along narrow roads, but small urban areas are easily overrun or isolated and have only small surpluses or stocks to sustain military operations. Simply put, size matters. Some urban areas are just not rich or large enough to be attractive military objectives. As Mosul illustrates, cities can serve as both the ends and the means for a military strategy while the operational ways in DUEs remain offensive, defensive, and stability operations. This article describes how Mosul's liberation foreshadows future LSCO because Mosul's size is more representative of global urban centers than the handful of megacities that grab popular attention.[14]

Five Operational Lessons from Mosul

While the duration and intensity of the Battle for Mosul surprised many observers, coalition commanders realized from the beginning that this battle would


Dense urban terrain
· Natural terrain
· Manmade structures and alterations
· Climate
· Material resources
· Implies evacuated population
Dense urban environment
Future military operations will often be conducted within the physical and contextual terrain of a dense urban environment characterized by human-centric complexity and change.
Human domain
· People, families, groups, and tribes
· Culture and information
· Relationships and flows
· Economics, politics, and power
· Difficult to define boundaries inside a single city

(Figure by Nicolas Fiore)

Figure 1. Dense Urban Environment

be different from recent urban operations—especially compared to IS's rapid capture of the city in 2014.[15] The study of Mosul's liberation holds significant value to military planners because it confirms that the complex interplay between space, force, and time is best managed through operational art. Several intuitive operational lessons leap out from media accounts of the battle. First, Mosul demonstrates that DUEs can be advantageous to either the attacker, the defender, or both, depending on who recognizes and best exploits the city through their operational approach and tactics.[16] Second, the battle illustrates that even subpeer threats can exploit DUEs to contest America's advanced capabilities, prolonging conflicts and increasing costs.[17] Finally, Mosul lays bare the fact that LSCO remains the decisive way of seizing a DUE from a determined defender, even when elements of a "by-with-through" strategy generate the means.[18]

Moving beyond media reports, a serious study of the battle reveals five counterintuitive or surprising operational lessons that should shape and inform future LSCO in DUEs:

- It is impossible to isolate a modern city.
- Difficulty increases with depth and duration.
- Attackers lose the initiative once they enter the city.
- Dense urban terrain enhances sustainment.
- Operational reach is proportional to population support.

The remainder of this article discusses these lessons and ways commanders can incorporate them into future campaign designs. Each subsection begins with a description of the phenomenon as observed in Mosul. Next, historical observations are provided to support the argument. Finally, the article recommends ways that commanders may apply the concept when planning future LSCO in DUEs.

Lesson 1: It is impossible to isolate a modern city. *Scale, mobility, and the ubiquitous cyber domain preclude tactical isolation.* U.S. doctrine considers the isolation of an urban objective essential for offensive operations and simultaneously catastrophic in the

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defense.[19] However, Mosul and other long-duration sieges challenge these assumptions.[20] Historical examples of LSCO in DUEs often involved the tactical isolation of the defender's city, but the difficulty of isolating cities increased as they grew larger and warfare incorporated additional domains.[21] In contemporary DUEs, infrastructure naturally increases internal mobility and offers numerous external routes that could exceed a besieger's capacity to control all avenues of approach. Additionally, ubiquitous communications technology and media coverage make isolation equally daunting—if not impossible. Even though a modern military can jam all communications, how would the United States strategically prevent journalism or word-of-mouth information sharing?[22] As the scale and complexity of a city increases, the difficulty of isolating it in all domains increases exponentially in the same way a sphere's surface area increases relative to its radius.

One hundred thousand soldiers encircled—but did not isolate—IS in Mosul. Coalition forces took only six weeks to envelop Mosul and interdict IS access to the Mosul-Tal Afar road, but surrounding Mosul with one hundred thousand soldiers did not operationally isolate the city's defenders or civilians because the coalition could not isolate IS physically or psychologically from the outside world.[23] IS maintained its lines of communication (LOC) to Tal Afar for the first four months of the campaign, despite a desert road being ideal for ground and air interdiction. Mosul's 200 sq km area is surrounded by a 50 km perimeter punctuated by ten major roads. Spread across open terrain, the coalition would have needed eight infantry brigades just to establish an inner cordon, but controlling access to Mosul's DUE was even more difficult.

IS's preparation of Mosul's DUE made controlling Mosul's perimeter even more complex. Buildings and rubble limited observation and cross-country movement and created irregular lines of contact.[24] Additionally, subterranean routes enabled IS counterattacks, which made the physical isolation of even uncontested sectors difficult.[25] Finally, civilians trapped in IS-controlled areas made psychological isolation impossible because information accompanied aid and smuggled supplies.

Similar conditions in World War II prevented LSCO attackers from isolating large cities. Siege, blockade, and relief therefrom have been tenets of warfare throughout history. In modern LSCO, siege and blockades are less successful at the operational level of war as ground combat has integrated other joint and government efforts. In World War II, the Soviet army sustained their forces in Stalingrad for three months using riverine operations; later, the German army used a meager air bridge to sustain trapped forces in the same city for almost as long. Both sides exploited key factors of Stalingrad's DUE—wharves, airstrips, and warehouses—to mitigate the absence of a traditional ground-based LOC and used the city's hardened structures to protect combat power from the attacker's superior firepower.

In 1994, Russian mechanized divisions chose not to isolate Grozny, a 130 sq km city of three hundred thousand people. Russian columns successfully penetrated the city but failed to decisively destroy the defending Chechen fighters due to the difficulty of employing mechanized weapons systems across the DUE and failing to plan for the depth and duration of the Chechen defense.[26] Conversely, the Chechen

Soldiers deployed in support of Combined Joint Task Force–Operation Inherent Resolve, assigned to 2nd Battalion, 325th Airborne Infantry Regiment, 2nd Brigade Combat Team, 82nd Airborne Division, use a rooftop as an observation post 7 March 2017 in Mosul, Iraq. (Photo by Staff Sgt. Alex Manne, U.S. Army)

commander incorporated Grozny's DUE into his operational plan to defend in three lines, avoid the effects of concentrated Russian firepower, shape media coverage, and exfiltrate forces for follow-on operations.[27]

Have realistic expectations for encirclement missions in DUEs. When designing an operational approach for LSCO in DUEs, commanders should consider whether isolation of a DUE is required or feasible. Encircling a large city will consume a large amount of combat power; recent urban battles demonstrate that complete isolation requires a unified JIIM effort and is harder than ever to achieve. If the enemy is the objective, then allowing the defender a LOC from their city gives the attacker the option to fight field battles near the LOC instead of inside the DUE. If the city is the objective, isolation could increase the defender's density as the attack progresses. As each assault becomes more difficult, tactical commanders will demand more fires to reduce or destroy strongpoints regardless of collateral damage.

For defensive LSCO in DUEs, commanders should prevent or delay encirclement for as long as possible. During this part of the operation, the wider the defender's perimeter is, the greater the opportunities for infiltration, raids, and counterattacks become. Commanders may be able to accept tactical and even operational encirclement if they are confident that they have enough depth to resist until relieved. Defending forces who plan for encirclement can stock critical supplies, prepare the terrain, and use infiltration to smuggle supplies, personnel, and information to prolong the defense.

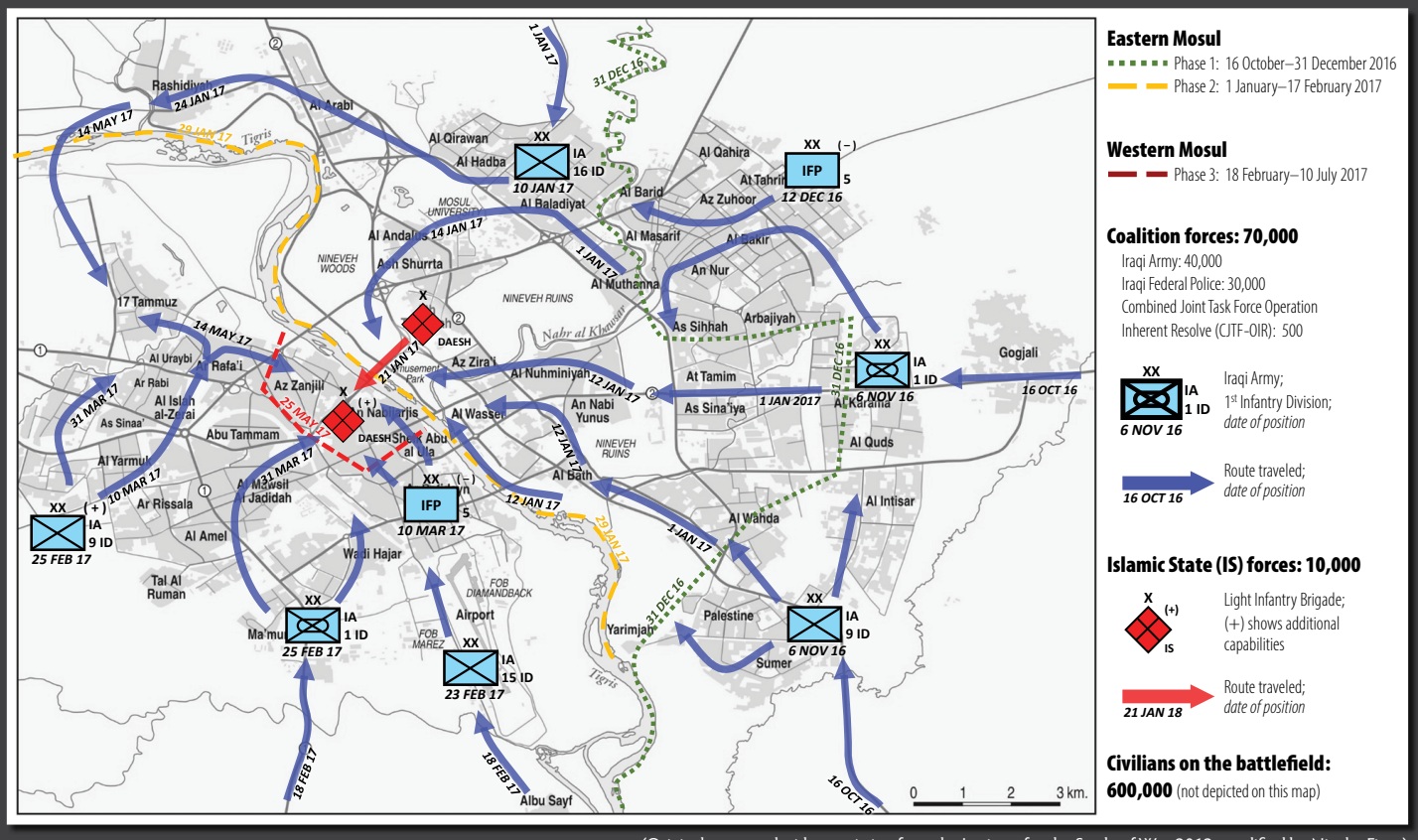
Lesson 2: On the offensive, difficulty increases with duration and depth. *The opening phase is always the attacker's easiest phase.* As a campaign advances, progress becomes more difficult for the attacker. This phenomenon is historically attributed to the lengthening of an attacker's LOC compared to the shortening of the defender's, and to the recent phenomenon that targeting becomes more difficult as the number of actionable target sets reduces over time. In LSCO, this phenomenon is magnified by the nature of DUEs, which gets progressively more formidable as fighting proceeds from skirmishes short of the city to fighting within suburban areas and concludes with continuous combat inside the city's core. In the opening phases of LSCO in DUEs, it often appears that the attacker's rapid progress will continue, tempting the attacker to commit reserves early in order to accelerate progress and decisively defeat the defender. In practice, as the attacker's tempo increases, the marginal gain from each assault decreases over time and proximity to the city's core.

Both IS and the coalition selected Mosul's Old City as the decisive point. Both IS and the coalition considered the al-Nuri Mosque, an 850-year-old national treasure in the heart of Mosul's Old City, to be the city's geographical and psychological center and therefore the operational objective.[28] From this perspective, IS's operational approach used Mosul's DUE to attrit coalition forces and husbanded its own military capability for the decisive battle in Mosul's Old City. In contrast, the coalition was continuously frustrated by the difficulty of seizing East Mosul's peripheral neighborhoods and key infrastructure to set conditions for the decisive attack to seize the city's core. Coalition measures of progress and predictions of victory were consistently inaccurate because tactical operations tended to decelerate as the DUE's density increased, IS adapted their tactics, and combat power was diverted to consolidate gains.

The Battle for Mosul began on 16 October 2016 with an expectation that the fighting would take three months.[29] This and subsequent time-specific forecasts proved optimistic. On 3 November 2016, a coalition spokesman said that the offensive was "ahead of schedule," but by early December, the battle was an operational stalemate in Eastern Mosul.[30] The coalition conducted an operational pause to regenerate combat power before pressing the attack and liberating eastern Mosul on 24 January 2017.[31] After approximately five more months of increasingly intense combat, the coalition declared victory on 9 July 2017 from the site of the destroyed al-Nuri Mosque. Despite the declaration, fighting in isolated pockets—predicted to last three days—continued for another two weeks.[32]

At the beginning of the battle, coalition ground forces were 40 km from the al-Nuri Mosque. Within a week, the coalition halved that distance to 20 km. After two more weeks, distance reduced to 10 km with the trend continuing in a negative logarithmic curve. Figure 2 (on page 65) shows the distance from the al-Nuri Mosque to the coalition front line of troops over time. As the coalition fought deeper into Mosul, the rate of gains decelerated from kilometers per day at the outset to single-digit meters per day by the end of

Battle for Mosul



(Original map used with permission from the Institute for the Study of War, 2012; modified by Nicolas Fiore)

Phase I

Iraqi army 1st and 9th Divisions entered the outskirts of eastern Mosul in early November 2016. The Iraqi 15th and 16th Divisions followed a few days later, with the 15th attacking from the south and the 16th from the north. By the end of the month, the Iraqi military assessed it had taken control of nineteen neighborhoods, nearly 30 percent of Mosul east of the Tigris River.

The attack continued into December. On 12 December, three Iraqi Federal Police brigades joined three special operations forces "Golden Division" counterterrorism brigades attacking in the east of the city. Pro-government forces conducted an operational pause at the end of the month to refit, repair, and rearm. Iraqi Prime Minister Haider al-Abadi stated that Iraqi forces were in control of over a third of Mosul.

Phase II

In late December, Iraqi forces continued their advance from three directions into eastern Mosul. The Islamic State (IS) fought back aggressively, cutting off a strategic road linking Mosul and Baghdad and shelled Shirqat after attacking a military barracks near Baiji to seize weapons. Iraqi forces regained control of the road, and on 12 January 2017, Iraq announced it was in control of about 85 percent of east Mosul.

On 21 January, CJTF–OIR announced they had targeted a flotilla of ninety boats and three barges being used by IS to escape across the Tigris River, and on 24 January, al-Abadi announced the "full liberation" of eastern Mosul.

On 13 February, IS forces launched an unsuccessful attack near Tal Afar (west of Mosul) to regain a line of communication between western Mosul and Raqqa, Syria.

Phase III

On 19 February, al-Abadi announced the commencement of the next phase of the operation that would capture western Mosul. On the 23rd, Iraqi forces attacked to seize the Mosul airport, and on the 24th, they entered western Mosul for the first time. Iraqi forces continued to advance, and on the 28th, the Iraqi 15th Division was preparing to storm Tal Afar to the west of Mosul.

Fighting intensified in March, with Iraqi forces making slow advances and IS fiercely counterattacking. By 11 March, Iraqi forces had reached the "Old City" center of Mosul, but the battle there continued through March and April, and into May. On 16 May, Brig. Gen. Yahya Rasool of Joint Operations Command stated during a press conference that government forces controlled 89.5 percent of western Mosul and had killed 16,467 IS members since the start of operation.

Iraqi forces continued to make deliberate progress through June and into July. On 10 July, al-Abadi declared victory, although isolated clashes continued for the next few months.

the operation.[33] Figure 2 also shows coalition casualties over time; it is noteworthy that 75 percent of the 8,200 coalition casualties were incurred during the intense Phase 3 fighting in West Mosul's Old City.[34]

Rapid geographic progress in the opening attack often leads to false confidence. Planning during the German siege of Stalingrad suffered from the same phenomenon. Rapid progress in the first two weeks of the attack penetrated the Soviet suburban perimeter and threatened to destroy two corps. German progress eventually slowed as the battle compressed Soviet defenders into the city's ever-thicker DUE, which eventually robbed the Germans of the initiative.[35] Three months from the beginning, the tables were turned and the Germans were themselves surrounded.[36]

U.S. Marines fighting to liberate Seoul in 1950 had a similar experience. It took the Marines two days to reach the edge of Seoul, one hundred miles from Incheon. The next day, the Marines crossed the Han River and advanced four more miles, but as the terrain grew hillier and enemy resistance increased, the pace slowed to one mile per day for four days. Although the Marines successfully captured the city, they did not accomplish their secondary objective of trapping all North Korean units south of Seoul because planners did not account for the increase in difficulty as operations advanced.[37]

Allocate the greatest share of resources for the most difficult phases of the operation. In Mosul, the coalition's best divisions sustained heavy casualties at the beginning of the operation and required several operational pauses to integrate replacements and deploy additional units before the attack could resume.[38] Commanders must consider the depth and expected duration, and then ensure that fresh forces will be available for the decisive fighting at the end of the battle. This can be accomplished by rotating units away from the front, by generating a fresh unit in time for the final assault, or by preserving combat power by holding elite units in the reserve. The last option may seem counterintuitive, but it would allow the commander to develop the situation, then commit the reserve later when the enemy is weaker. If the defender's perimeter is still broad and thin, the attacker could penetrate the DUE's core and destroy the defender's interior lines before the deepest defenses can be established. Defending commanders should maintain a dedicated counterattack or spoiling attack force, then quickly replace it with general defense forces who will absorb the attacker's return blow.

Lesson 3: Attackers lose the initiative as soon as they enter the city. *"Storm or siege" is the attacker's last free choice.* Historically, the attacking commander has the operational initiative for the preponderance of a LSCO campaign. The strategic decision to initiate hostilities is usually associated with the ability to commit forces superior to the defending military. If defeated in the field, the defender may retreat to a large city to use its DUE to preserve force, extend operational reach, and gain the tactical initiative.[39] Often the attacker may not bypass the city due to its strategic or operational value, and must choose to assault or besiege the city. Once the attacker invests a city, the siege continues until it culminates in a successful assault or the siege is defeated. Attackers can choose to mass their full capability anywhere on the defender's perimeter, but once the attacking forces are inside the DUE, their commitment is typically irrevocable. This "storm or siege" decision is difficult but unconstrained—the defender must wait, unable to influence that decision.

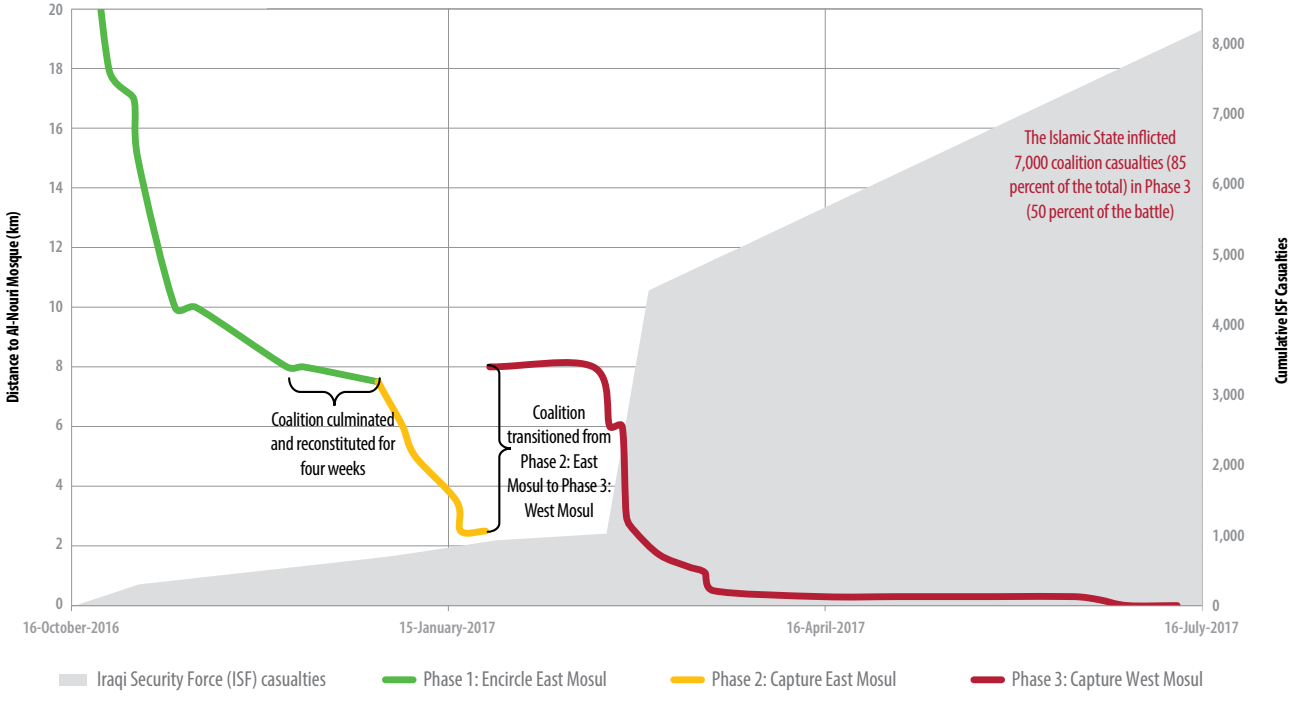
IS maintained the initiative in Mosul by controlling the fight's tempo and conditions. In May 2015, IS defeated the first coalition operation to liberate Mosul with a spoiling attack that seized Ramadi. Over the next eighteen months, the coalition defeated IS's ability to conduct offensive operations and began the campaign to invest the Mosul metropolitan area. In October 2016, the Iraqi prime minister announced the operation to liberate Mosul. IS's operational response was a contiguous area defense-in-depth with tactical spoiling attacks and counterattacks to disrupt the coalition during tactical transitions.[40]

The coalition was able to bring overwhelming combat power to every assault, but inside Mosul, the friction of attacking through prepared terrain and IS's dynamic defense nullified many of the coalition's warfighting advantages. IS integrated obstacles and employed novel combinations of military hardware and civilian equipment to contest coalition land operations from multiple domains. IS retained the operational initiative by varying resistance by sector to control the tempo of the battle, massing fires to culminate specific coalition units, and adapting sustainment basing as the operation progressed.[41]

The scale of the operation and IS's use of Mosul's DUE made it difficult for the coalition to influence IS's operational decisions, despite coalition air supremacy, continuous strikes, and daily attritional gains. By December, the coalition culminated, and IS decided not

to retrograde from Mosul. Instead, they allowed the encirclement of ten thousand personnel with a new goal to attrit so many Iraqi soldiers that the coalition would lose its will to continue the campaign.

During the operational pause, the coalition consolidated gains, prepared to resume the offensive, and then successfully seized eastern Mosul. IS prevented the coalition from projecting force across the Tigris River, which forced the coalition to repeat the operational approach in western Mosul. The coalition did not completely regain the initiative until March when it defeated IS's ability to use the Tal Afar road and constricted the remaining five thousand defenders to the 10 sq km perimeter of Mosul's Old City.[42]



(Figure by Nicolas Fiore. Offensive territory gains declined exponentially but casualty rates increased as the battle progressed toward Mosul's core, even with two operational pauses to consolidate.)

Figure 2. Distance to al-Nuri Mosque in Mosul's Old City from the Nearest Iraqi Security Force Unit Over Time (with ISF Casualties)

DUE combat has defeated many excellent field armies. Sun Tzu advised commanders to avoid besieging and attacking walled cities because LSCO in DUEs risks the attacker's army.[43] Besides high casualties, prolonged sieges degrade readiness, erode operational reach, and surrender the initiative. Even successful LSCO in a DUE can culminate an army. In 1942, German Army Group B seized Stalingrad but at the cost of its operational armored capability, without which it was unable to counterattack or break out from Soviet Operation Uranus.[44] The campaign also took too long. By the time Stalingrad was seized, the operational planning assumptions were no longer valid, the entire front's summer offensive was desynchronized, and the Germans never regained the operational initiative against the Soviet Union.

The 1994 Russian operation in Grozny suffered from many intrinsic factors, but Russian forces would probably have performed better outside of Grozny's DUE. Superior fires, mobility, and sustainment capabilities might have helped Russia retain the initiative in a field campaign. Instead, the decision to storm Grozny in four columns was the last time Russia enjoyed the freedom of maneuver against an inferior force constrained to the city's core. Chechen separatists retained the operational initiative for two

weeks until fresh Russian forces arrived to employ a new fires-centric operational approach that secured Grozny but destroyed much of the city and attrited Russia's military capability and political will necessary for follow-on operations.[45]

Attackers can retain the initiative by synchronizing operations to seize essential objectives. The Israel Defense Forces (IDF) used a methodical but semicontiguous approach in their 1982 campaign to destroy the Palestinian Liberation Front in Beirut, Lebanon. Israel's operational approach in Beirut consisted of a contiguous siege line to beleaguer Palestine Liberation Organization (PLO) forces for seven weeks, supplemented with daily strikes and limited-objective ground penetrations to maintain the operational initiative.[46] The air, artillery, and ground raids destroyed enemy concentrations, prevented the PLO from counterattacking successfully, and continuously attrited PLO capability at low risk to the IDF.[47] Scope and time were critical elements of the Israeli operational approach. The IDF had permissive rules of engagement and sufficient time to develop each tactical strike and raid, and the Israeli army intentionally kept the siege frontage broad in order to spread PLO defensive forces across a wide array of tactical objectives.

Maintain the initiative to avoid general combat along a linear front. At the tactical level of war, DUEs can equalize combat capabilities as two forces fight in close proximity, with limited line of sight, in a hardened area dense with civilian presence. There is a tendency in LSCO in a DUE for combat to settle into an impasse along a linear front, especially if strategic objectives limit the time available to prepare for the operation. Linear contiguous fronts may seem unavoidable in DUEs as attackers maneuver to encircle and sever exterior lines of communication, while defenders establish positions to secure interior lines. Attackers and defenders can, however, maintain the operational initiative by controlling the tempo of combat, using reserves and strikes to desynchronize and defeat the enemy's offensive capability, and prioritizing the destruction of enemy concentrations more than control of terrain. Commanders should design their approach to mitigate DUEs' tactically equalizing effect.

Lesson 4: Dense urban terrain enhances sustainment. *Cities both complement and supplement military sustainment.* There is a myth that urban terrain favors the defender—that logic does not apply to any other type of terrain and should not be accepted about DUEs.[48] Terrain can favor any operational approach that is crafted to take advantage of its natural and potential characteristics. Uniquely, DUEs are the only severely restricted terrain that offers complements and substitutes to enhance sustainment.[49] Compared to other types of severely restricted terrain (e.g., jungles, mountains, and swamps), DUEs have numerous features that can offer both sides operational advantage: roads, concealment, and reservoirs of civilian manpower. This section will discuss incorporating DUE into LSCO operational design separate from incorporating the population into LSCO because even a depopulated city, such as Stalingrad, can offer military advantage.

Mosul's DUE supported both IS and coalition operations. IS's operational approach used Mosul's DUE to create a near unassailable defense-in-depth.[50] In no other terrain could IS have equipped, sheltered, and supplied as large and capable a force against coalition attack so effectively and for so long. In Mosul, IS's sustainment operations used complementary assets such as hospitals, warehouses, roads, and civilian vehicles to augment their militia-like capabilities. The scale of Mosul's DUE supplemented IS's ability to resupply the defenders from their support zone in Syria and Tal Afar until Mosul was finally encircled. Even then, IS paid and coerced civilians to harvest the city for all classes of supply to sustain a robust defense for four more months.[51] This effort yielded unexpected substitutes such as locally-crafted unmanned aircraft systems (UASs) and vehicle-borne improvised explosive devices (IEDs) to replace traditional intelligence and fires capabilities.[52] Finally, the extended duration gave IS fighters time to develop and improve tactics for their employment.

As fighting in eastern Mosul intensified, the coalition also adapted their sustainment to the DUE's organic advantages. IS's lack of long-range artillery allowed the coalition to compress their tactical sustainment systems into newly consolidated neighborhoods. Soldiers occupied buildings instead of tents, and sustainment infrastructure moved into the city and was distributed to smaller and more numerous tactical support areas only a few blocks from the front lines. Combat power was allocated to restoring essential services in newly liberated neighborhoods, while hospitals served as a substitute for external refugee camps.[53] Civilian bulldozers were commandeered to fill essential mobility and protection gaps, and even

Iraqi Counter Terrorism Service surgeon Lt. Col. Hayder al-Sudani treats a girl at a processing station for internally displaced people 3 March 2017 near Mosul, Iraq. (Photo by Staff Sgt. Alex Manne, U.S. Army)

used as a substitute for mechanized infantry support in combat.[54] These sustainment complements and substitutes are not organically available in any other terrain and would have required slow and expensive procurement to create the same tactically enabling results.

Defenders tend to exploit LSCO in DUEs sustainment opportunities best. IS, like most defending forces in history, had time to prepare for and tailor sustainment practices for Mosul's DUE. Defenders are able to benefit from DUEs over a longer period of time before combat degrades sustainment opportunities. Mosul, Beirut, and Grozny fit the pattern for LSCO in a DUE where defenders employ intact terrain to sustain a delay operation, causing attackers to employ massed firepower in an attempt to attrit the defenders, increase tempo, and regain the initiative. As a result, attackers usually seize damaged terrain that is less valuable to their operational efforts than it was to its previous defenders. IS's ability to manufacture weapons under LSCO siege was innovative but not novel, some Russian factories in Stalingrad operated until the day the Germans captured them. The Germans, however, did not—or could not—use the same infrastructure when they were later besieged. Defenders usually have an internal mobility advantage in DUEs due to road infrastructure, but attackers do not gain an equal advantage as they seize terrain because the fighting often degrades the trafficability of captured roads.

Integrate DUEs sustainment assets into the operational approach. All terrain confers military advantages and disadvantages, but DUEs are unique in their ability to sustain combat power. In their 1982 operation in Beirut, the Israeli army appreciated this fact and carefully avoided combat in areas that could offer military value later in the operation. Commanders should assess the value of a city's key terrain and general urban infrastructure to both the attacker and the defender, looking to use or deny complements and substitutes over the scope of the operation. Sustainers should also anticipate that DUEs tend to disaggregate forces more than other terrain and may require a different distribution plan.

Lesson 5: Operational reach is proportional to population support. *Local people can concretely assist, or hinder, the employment of combat power.* At the strategic level, joint doctrine primarily envisions civil-military interaction in the information and cognitive environments to influence the popular attitudes that shape a society's collective action in support of one combatant or the other.[55] The Battle of Mosul and other historical LSCO in DUE campaigns suggest that, at the operational level, both attackers and defenders should employ resources in the physical environment to mobilize individuals and groups to achieve operational objectives. Population support is the Maoist concept that the people's aggregate actions—related to but not entirely dependent on their attitudes—can enhance or degrade warfighting and operational reach.[56] In a DUE, tens of thousands of people who can support or interfere with operations live in extreme proximity and therefore have consistent opportunities to do so. The aggregate of a DUE objective's population support can decisively enable or frustrate a combatant's ability to achieve operational objectives.

IS used Mosul's civilians to extend its operational reach—both in duration and distance. In 2014, IS seized Mosul and large portions of Iraq using a small military force enabled by population support. Sympathetic individuals, Baath-affiliated groups, and captured government facilities provided information, sustainment, and even combat power to allow the IS attack to seize and then consolidate gains further and faster than anyone anticipated.[57] During the two years IS occupied Mosul, it invested significant resources and manpower to control the population's attitudes, beliefs, and actions through a combination of intimidation and incentives because IS would need population support to sustain its defense of Mosul.

When the coalition attacked in strength, IS's regular military force consisted almost entirely of light infantry maneuver and short-range fires capabilities. All other warfighting functions were performed by civilians—local and foreign—contributing population support within Mosul's DUE.[58] Mission command was facilitated by civilian couriers who provided assured communications. Intelligence came from

The United Kingdom Bridge Training Team advises and assists Iraqi security forces 20 March 2018 in construction of an Acrow Poseidon bridge over the Tigris River in Mosul, Iraq. This effort is part of Combined Joint Task Force–Operation Inherent Resolve, the global coalition to defeat the Islamic State in Iraq and Syria. (Photo by Pfc. Anthony Zendejas IV, U.S. Army)

civilian human and open-source intelligence analysis. Civilians dug communications tunnels and trenches, drove bulldozers to build berms, and served as mobile protection platforms to deter coalition strikes. Civilian households distributed all classes of supply to small units and provided medical support, and civilian labor manufactured weapons including precision UAS-IEDs, vehicle-borne IEDs, and suicide vest IEDs from commercial off-the-shelf components.

Exit interviews with refugees indicate that much of this population support may have been involuntary, yet their physical contribution to IS's war effort was critical to the duration and effectiveness of IS's operational reach.[59] IS harnessed the hundreds of thousands of civilians in Mosul's economic footprint to produce and distribute supplies with minimal manpower, providing an extremely favorable tooth-to-tail ratio that allowed them to project more combat power further than a similar conventionally organized and sustained force. On the opposite side, the same civilian population did comparatively little to enhance coalition operations. Once liberated by the legitimate government, civilians escaped to safety and the coalition expended resources and combat power to secure and sustain the civilians: soldiers distributed supplies, provided medical care, and constructed shelters, adding to a net reduction in coalition operational reach.

In LSCO in DUEs, the population usually provides more support to the defender. Historically, DUE defenders extract physical support from urban populations, while the task of rebuilding the city and restoring its society falls to the attacker. Unless the attacker has full surprise, defenders usually have time to integrate civilian manpower into an operational approach that demands social cohesion to "defend our homes." Defenders often coerce population support through a combination of appeals to a common identity, incentives, and threats of violence. The defender also benefits from a siege's effect on the city's economy: with external commerce interrupted, the lack of competing economic activity suppresses the price of labor to, or even below, subsistence levels. Irregular militaries go to great lengths to maintain control of this captive labor market because they rely on civilian population support to provide combat forces with additional capabilities and operational reach.[60] In contrast, professional militaries avoid incorporating population support into their offensive or defensive operational approach because they are usually sustained organically from national support and prefer to evacuate the population in order to use fires with reduced risk of civilian casualties.

Invest resources to mobilize and extract concrete support from the population. Joint doctrine stipulates that one of the fundamentals of urban operations is to "persuade municipal governments, groups, and population segments to cooperate with joint force operations."[61] LSCO in DUEs are usually of long-enough duration that commanders should invest resources and establish an expert JIIM team to convert potential population support into improved operational reach.[62] In a friendly country—perhaps, the defense of a NATO partner—an operational approach could contract civilian labor, recruit local volunteers as human intelligence sources along LOCs to enhance rear area security, and augment humanitarian assistance for displaced people. Active population participation may prove decisive by improving cohesion, legitimacy, and the likelihood of sustaining the defense long enough for strategic relief. Militaries that choose not to incorporate population support into their operational design leave locals idle and risk their adversary discovering a way to harness the latent population support.

Conclusion: Militarize the DUE in the Operational Approach

The coalition defeated IS's tenacious defense and liberated Mosul by integrating violent Iraqi ground maneuver with advanced U.S. capabilities within Mosul's militarized DUE.[63] The 2017 Mosul Study acknowledged the benefit that Mosul's DUE offered to the coalition, saying that "U.S. soldiers and Iraqi soldiers did not merely endure close urban combat but also adapted not only their tactics, techniques, and procedures, but also technology [to defeat IS]."[64] The *Army Operating Concept* anticipates LSCO against near-peer threats in cities characterized by dense urban terrain.[65] In order to seize or defend a DUE objective without culminating, commanders must militarize the terrain to identify and assimilate its unique opportunities into their operational design and tactics. Historically, the most innovative uses of DUEs are uniquely tailored to a specific city and rely heavily on support from the city's existing infrastructure and population to generate complementary and supplementary capabilities. Instead of

adjusting operational approaches to a city, commanders should incorporate elements of that city into their operational approach with the goal of retaining the initiative and extending operational reach while preserving combat power late into the decisive phase of the battle. Commanders can tailor the degree of isolation required, fight for select objectives to control the tempo and location of ground combat, and avoid the high attrition and material cost that historically characterize LSCO in DUEs. ■

Notes

1. Joseph M. Martin, interview in "Commander's Perspective: CJFLCC Operations in Iraq," *CALL [Center for Army Lessons Learned] News from the Front*, 26 October 2017, 8, accessed 2 November 2018, https://usacac.army.mil/sites/default/files/publications/17567.pdf; William Hedges, "An Analytic Framework for Operations in Dense Urban Areas," Small Wars Journal, 11 March 2016, accessed 9 October 2018, http://smallwarsjournal.com/jrnl/art/an-analytic-framework-for-operations-in-dense-urban-areas. Maj. Gen. Joseph M. Martin first used the term "dense urban terrain" to describe old Mosul; however, the definition that best separates dense urban terrain from broader megacity discussions was provided by Command Sgt. Maj. William Hedges when he described "dense urban areas"; see also David Kogon, "The Coalition Military Campaign to Defeat the Islamic State in Iraq and Syria AUG 2016–05 SEP 2017," U.S. Army Campaign History: CJTF–OIR (unpublished, declassified 3 September 2017), 4.

2. Field Manual (FM) 3-0, *Operations* (Washington, DC: U.S. Government Publishing Office [GPO], October 2017), para. 2-62. Large-scale combat operations are those that utilize echelons above brigade as actual warfighting formations and not just as headquarters.

3. Combined Joint Task Force–Operation Inherent Resolve (CJTF–OIR), "The Campaign," CJTF–OIR (website), accessed 9 October 2018, http://www.inherentresolve.mil/campaign/.

4. Gary Volesky and Roger Noble, "Theater Land Operations: Relevant Observations and Lessons from the Combined Joint Land Force Experience in Iraq," *Military Review* Online Exclusive, 22 June 2017, accessed 9 October 2018, http://www.armyupress.army.mil/Journals/Military-Review/Online-Exclusive/2017-Online-Exclusive-Articles/Theater-Land-Operations/.

5. The map was constructed from open source coalition announcements that cited units, locations, and dates. The U.S. Army Campaign History: CJTF–OIR estimated the Islamic State (IS) strength in Mosul at 3,000 to 5,000 fighters (light infantrymen) inside Mosul and 1,000 to 2,500 in perimeter areas; but to keep strength estimates in line with historical convention, our estimate of 10,000 total IS personnel also includes the combat support and service support personnel that gave IS an equivalent strength of two light infantry brigades. The CJTF–OIR History estimates a coalition campaign strength of 94,000, including allied militia, which we have rounded to 100,000 to account for casualty replacements. The map depicts the estimated 70,000 Iraqi Security Forces soldiers who fought inside Mosul. See Kogon, "The Coalition Military Campaign," 15–16.

6. Mike Lundy and Rich Creed, "The Return of U.S. Army Field Manual 3-0, *Operations*," *Military Review* 97, no. 6 (November–December 2017): 14–20.

7. FM 3-0, *Operations*, ix–xii.

8. Tim Lister, Mohammed Tawfeeq, and Angela Dewan, "Iraqi Forces Fight IS on Mosul Streets," CNN, 4 November 2016, accessed 9 October 2018, http:// www.cnn.com/2016/11/03/middleeast/mosul-offensive-iraq-troops-in/.

9. Roger J. Spiller, "On Urban Operations and the Urban Environment," in *Sharp Corners: Urban Operations at Century's End* (Fort Leavenworth, KS: U.S. Army Command and General Staff College Press, 2001), 1–37.

10. Army Techniques Publication (ATP) 3-06, *Urban Operations* (Washington, DC: U.S. GPO, December 2017), 1-1.

11. Joint Publication (JP) 3-06, *Joint Urban Operations* (Washington, DC: U.S. Government Printing Office, November 2013), I-6.

12. Ibid, I-2.

13. Ibid.

14. There are forty-six megacities on Earth today. There are approximately one thousand "middleweight" cities of populations between five hundred thousand and 9.9 million people. Historically and statistically speaking, military operations are more likely to occur in urban areas smaller than megacities. For an expanded discussion, see Hedges, "An Analytic Framework for Operations."

15. Dan Lamothe et al., "Battle of Mosul: How Iraqi Forces Defeated the Islamic State," *Washington Post* (website), 10 July 2017, accessed 9 October 2018, https://www.washingtonpost.com/graphics/2017/world/battle-for-mosul/; Adnan R. Khan, "What Went Wrong in Mosul," Maclean's, 23 February 2017, accessed 9 October 2018, https://www.macleans.ca/news/world/what-went-wrong-in-mosul/.

16. Mosul Study Group 17-24U, *What the Battle for Mosul Teaches the Force* (Fort Eustis, VA: U.S. Army Training and Doctrine Command [TRADOC], September 2017), 28–39.

17. Stephen J. Townsend, "Multi-Domain Operations in Megacities" (presentation, Association of the United States Army 2017 LANPAC Symposium & Exposition, Honolulu, 23 May 2018).

18. Volesky and Noble, "Theater Land Operations."

19. ATP 3-06, *Urban Operations,* 4-58, 5-36.

20. Townsend, "Multi-Domain Operations in Megacities."

21. Thucydides, *The Landmark Thucydides: A Comprehensive Guide to the Peloponnesian War*, ed. Robert B. Strassler (New York: Free Press, 2008), 98–104. Sparta's futile attempts to isolate Athens during the first year of the Peloponnesian War are a good example.

22. Spiller, "On Urban Operations," 89.

23. "Mosul Battle: Iraq Militias 'Cut off IS Access to City,'" BBC News, 23 November 2016, accessed 9 October 2018, http://www.bbc.com/news/world-middle-east-38079602.

24. Richard E. Simpkin, *Race to the Swift: Thoughts on Twenty-First Century Warfare* (Washington, DC: Brassey's Defence, 1985). Dense urban environment is not universally severely restrictive terrain; urban areas increase mobility along certain avenues but severely restrict movement in all other directions. Simpkin would have called this going against the grain of the terrain.

25. Mosul Study Group 17-24U, *What the Battle for Mosul Teaches the Force*, 37.

26. Kendall D. Gott, *Breaking the Mold: Tanks in the Cities* (Washington, DC: U.S. Government Printing Office, 2006), 77–82.

27. Olga Oliker, *Russia's Chechen Wars 1994-2000: Lessons from Urban Combat* (Santa Monica, CA: RAND Corporation, 2001), 16–22.

28. Falih Hassan and Tim Arango, "IS Destroys Al Nuri Mosque, Another Loss for Mosul," *New York Times* (website), 21 June 2017, accessed 9 October 2018, https://www.nytimes.com/2017/06/21/world/middleeast/mosul-nuri-mosque-isis.html.

29. Kareem Shaheen, "Iraqi PM Visits Ramadi after Declaring IS Will Be 'Terminated' in 2016," *The Guardian* (website), 29 December 2015, accessed 9 October 2018, https://www.theguardian.com/world/2015/dec/28/iraq-declares-ramadi-liberated-from-islamic-state.

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31. Kimberly Dozier, "Top U.S. General: Two More Years to Beat IS," Daily Beast, 25 December 2016, accessed 2 November 2018, https://www.thedailybeast.com/top-us-general-two-more-years-to-beat-isis; W. G. Dunlop, "Iraq Announces 'Liberation' of East Mosul," Yahoo News, 18 January 2017, accessed 9 October 2018, https://www.yahoo.com/news/top-iraq-commander-announces-liberation-east-mosul-112326673.html.

32. Seth Robson, "Civilians Return to Mosul as Iraqi Forces Mop up Residual IS Fighters," *Stars and Stripes* (website), 21 July 2017, accessed 9 October 2018, https://www.stripes.com/news/civilians-return-to-mosul-as-iraqi-forces-mop-up-residual-IS-fighters-1.479136.

33. Distance compiled by author based on numerous media reports of coalition progress in locations around the city.

34. Kogon, "The Coalition Military Campaign," 35.

35. B. H. Liddel Hart, *History of the Second World War* (New York: Putnam, 1970), 258.

36. Louis A. DiMarco, *Concrete Hell: Urban Warfare from Stalingrad to Iraq* (Oxford, UK: Osprey, 2012), 37.

37. Ibid., 78.

38. Stephen Kalin, "Iraqi Forces in Mosul Mostly in Refit Mode: U.S. General," Reuters, 21 December 2016, accessed 9 October 2018, https://www.reuters.com/article/us-mideast-crIS-iraq-mosul-idUSKBN14A197.

39. Spiller, "On Urban Operations," 89.

40. Kogon, "The Coalition Military Campaign," 15.

41. Lydia Kautz, "Martin Details Liberation of Mosul," *Junction City Daily Union* (website), 23 August 2017, accessed 10 October 2018, http://www.jcdailyunion.com/news/martin-details-liberation-of-mosul/article_5778a9b4-886a-11e7-8a32-17b6bfdec63e.html.

42. Stephen Kalin, "Iraqi Army Controls Main Roads out of Mosul, Trapping Islamic State," Reuters, 1 March 2017, accessed 10 October 2018, https://www.reuters.com/article/us-mideast-crIS-mosul-road-idUSKBN1683H8.

43. Roger T. Ames, trans., *Sun-Tzu: The Art of Warfare* (New York: Ballantine Books, 1993), 111.

44. Hart, *History of the Second World War,* 263.

45. DiMarco, *Concrete Hell,* 151–68.

46. Avi Shlaim, *The Iron Wall: Israel and the Arab World* (New York: W. W. Norton, 1999), 410.

47. Gott, *Breaking the Mold,* 65.

48. JP 3-06, *Joint Urban Operations,* I-7.

49. Standard professional economics terminology. Briefly, a complementary good is something that, when combined with an existing asset, increases value of both the original asset and its newly acquired complement. In warfighting terms, this is something that increases the effectiveness of an existing military asset (tanks without fuel are expensive bunkers). A substitute good is a replacement that is as effective as the original. We prefer to use the least valuable substitute that can still accomplish the mission, such as unmanned aircraft systems (UAS) instead of aircraft for close air support; furthermore, we prefer to use artillery to free UAS platforms for reconnaissance.

50. Mosul Study Group 17-24U, *What the Battle for Mosul Teaches the Force*, 34.

51. Ibid., 38–40.

52. Ibid., 32.

53. Ibid., 40.

54. Ibid., 43.

55. JP 3-06, *Joint Urban Operations,* IV-7.

56. John Shy and Thomas W. Collier, "Revolutionary War," in *Makers of Modern Strategy: From Machiavelli to the Nuclear Age*, ed. Peter Paret (Princeton, NJ: Princeton University Press, 1986), 839–42.

57. Tim Arango, "Uneasy Alliance Gives Insurgents an Edge in Iraq," *New York Times* (website), 18 June 2014, accessed 10 October 2018, https://www.nytimes.com/2014/06/19/world/middleeast/former-loyalists-of-saddam-hussein-crucial-in-helping-isis.html.

58. John Beck, "How ISIL Used Government Workers to Control Mosul," Al Jazeera, 10 August 2017, accessed 10 October 2018, https://www.aljazeera.com/indepth/features/2017/08/isil-government-workers-control-mosul-170803142445067.html.

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60. These "irregular militaries" include protonational forces like the Palestine Liberation Organization and Hezbollah; separatist militias local to Chechnya, Ukraine, and Syria; and franchise insurgencies like IS, al-Qaida, the Taliban, and some international narcotics gangs.

61. JP 3-06, *Joint Urban Operations,* I-12.

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63. Loveday Morris and Mustafa Salim, "After a Slow and Bloody Fight against IS, Iraqi Forces Pick Up the Pace in Mosul," *Washington Post* (website), 14 January 2017, accessed 10 October 2018, https://www.washingtonpost.com/world/middle_east/after-a-slow-and-bloody-fight-against-IS-iraqi-forces-try-to-pick-up-the-pace-in-mosul/2017/01/13/c5b30648-d43f-11e6-9651-54a0154cf5b3_story.html.

64. Mosul Study Group 17-24U, *What the Battle for Mosul Teaches the Force*, 10.

65. TRADOC Pamphlet 525-3-1, *The U.S. Army Operating Concept: Fight and Win in a Complex World* (Fort Eustis, VA: TRADOC, 31 October 2014), 8.